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(19) (CA) **APPLICATION FOR CANADIAN PATENT** (12)

(54) Drilling Fluid

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(57) 8 Claims

Notice: The specification contained herein as filed

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DRILLING LIQUID

The present invention relates to a drilling liquid for use to drill a deep well to an underground formation, generally deeper than 3 000 m.

5 To drill such a well a drilling liquid is required that assist in maintaining the maximum drilling rate, removes drill cuttings from the bottom of the hole, supports and protects the wall of the hole and cools the drill bit.

Such a drilling liquid is suitably an aqueous liquid and to improve the drilling liquid oil is added to the aqueous system.

10 It is an object of the present invention to provide a drilling liquid which is substantially free of hydrocarbon oil.

It is a further object of the present invention to provide a drilling liquid which can strengthen a borehole wall, provide lubrication and stabilize shale at temperatures above about 100 °C.

15 To this end the drilling liquid comprising a mixture of powdered sulphur dispersed in an aqueous liquid, the amount of sulphur being between 0.03 and 0.30 kg per kg of drilling liquid.

In the specification and in the claims the term "powdered sulphur" is used to refer to sulphur in the form of discrete
20 particles having a dimension which is less than 1 000 μm (= 1mm).

Reference is made to Russian patent publication No. 1 004 442 disclosing an aqueous drilling liquid which contains a minor amount, up to 2.5% by mass of sulphur to the aqueous liquid in order to ensure the thermal stability of the drilling liquid.

25 An advantage of the drilling liquid of the present invention is that at surface conditions the sulphur particles are solid, and thus they can easily be handled, whereas at down hole conditions, at a temperature above 113 °C (which is the melting point of sulphur) the sulphur melts and a liquid sulphur-in-water emulsion
30 is formed.

It was found that this sulphur-in-water emulsion had the same good rheological and filter properties as a conventional oil-in-water emulsion.

5 Suitably the amount of sulphur is between 0.10 and 0.30 kg per kg of drilling liquid. A sulphur content in this range is particularly suitable if it is required that wall building, lubrication and shale stabilization properties of the drilling liquid are to be improved.

10 To prevent interception on the shale shaker, suitably the sulphur particles have a dimension of less than 100 μm .

The aqueous liquid can suitably be selected from the group consisting of fresh water, sea water and brine. The brine suitably consists of an aqueous solution of at least one salt selected from the group including sodium chloride, potassium chloride, calcium chloride, magnesium chloride, the amount of salt being between 15 0.03 kg per kg of solution and the amount of salt which saturates the solution.

The invention will now be described by way of example in more detail. An example drilling liquid according to the present invention is prepared as follows. To 1 m_3 of fresh water were added 20 under agitation (shear rate up to 300 1/s) 60 kg of bentonite, 3 kg of carboxymethylcellulose and 5 kg of lignosulphonate, after one hour of mixing at the above shear rate were added 120 kg powdered sulphur and about 3.5 kg caustic soda. The particle size of sulphur was as follows: 90% by mass smaller than 53 μm (ASTM sieve No. 270) 25 and 100% by mass smaller than 64 μm (ASTM sieve No. 200). After a further hour of mixing at the above shear rate, the drilling liquid was tested. Its density was 1 095 kg/m_3 and its pH was 8.0. The API filterloss was 9 ml (millilitre), the plastic viscosity was 5 $\text{mPa}\cdot\text{s}$ and the yield point 15 Pa. The filter loss and the rheological 30 properties were determined as follows: at 115 °C and 200 kPa using a conventional high pressure/high temperature filterloss apparatus from Baroid and a high pressure/high temperature viscosimeter (Fann 50c) substantially as described in G.R. Gray and H.C.H. Darley,

Composition and properties of oil well drilling fluids, 4th Ed.
1980, pages 96-102.

5 To obtain a sodium chloride drilling liquid according to the
invention 100 kg NaCl is added to 1 m³ of fresh water and then were
added under agitation (shear rate up to 300 l/s) 60 kg of attapul-
gite, 3 kg of carboxymethylcellulose and 5 kg of lignosulphonate,
after one hour of mixing at the above shear rate were added 120 kg
powdered sulphur and about 3.5 kg caustic soda. The filter loss and
rheological properties of this drilling liquid did not differ
10 significantly from the properties of the above fresh water drilling
liquid.

A conventional mineral oil-in-water emulsion drilling liquid
contains about 15% by mass of oil and furthermore it includes
approximately the same amounts of clay, salt, cellulose, ligno-
15 sulphonate and caustic soda as the above drilling liquids. Such an
emulsion drilling liquid has the the same filterloss and rheolo-
gical properties as the above sulphur emulsion drilling liquid.

From this comparative example it can be seen that the the
drilling liquid according to the present invention is a suitable
20 one replacing a mineral oil containing drilling liquid.

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1. Drilling liquid comprising a mixture of powdered sulphur dispersed in an aqueous liquid, the amount of sulphur being between 0.03 and 0.30 kg per kg of drilling liquid.
2. Drilling liquid as claimed in claim 1, wherein the amount of sulphur is between 0.10 and 0.30 kg per kg of drilling liquid.
3. Drilling liquid as claimed in claim 1 or 2, wherein the sulphur particles have a dimension of less than 100 μm .
4. Drilling liquid as claimed in any one of the claims 1-3, wherein the aqueous liquid is selected from the group consisting of fresh water, sea water and brine.
5. Drilling liquid as claimed in any one of the claims 1-4, further comprising suspended solids selected from the group including clay, bentonite, attapulgitite, calcium carbonate, barite, hematite and siderite, the amount of suspended solids being between 0.01 and 0.30 kg per kg of drilling liquid.
6. Drilling liquid as claimed in any one of the claims 1-5, further comprising pH adjusting agents selected from the group including caustic soda, sodium carbonate and sodium bicarbonate.
7. Drilling liquid as claimed in any one of the claims 1-5, further comprising an additive selected from the group of carboxymethyl-cellulose, hydroxyethylcellulose, polyacrylate, xanthan gum, a heteropolysaccharide, a succinoglycan and lignosulphonate, the amount of additive being between 0.01 and 0.03 kg per kg of aqueous liquid.
8. Drilling liquid substantially as described in the specification with reference to the examples.

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DRILLING LIQUID

Drilling liquid comprising a mixture of powdered sulphur dispersed in an aqueous liquid, the amount of sulphur being between 0.03 and 0.30 kg per kg of drilling liquid.